small an altitude. In the absence of the original observations, we can only conjecture that the supposed moving object or second comet, was none other than the Melbourne comparison star 8 Leporis (commonly estimated 6m.), and it may have been under this impression that Mr. Ellery did not think it necessary to reply to the telegram sent to him from Castlemaine. The motto of the Royal Astronomical Society, "*Quicquid nitet notandum*," upon the principle of which Dr. Bone says he acted in putting his observation upon record, is a good one no doubt, but where there is suspicion of error it is desirable to be in possession of all particulars, and in this view we would suggest the early publication of his comparisons as they were actually made.

A NEW COMET.—A comet discovered in America, apparently on March 18, is likely to become a conspicuous object before perihelion, which, according to the first rough orbits, does not take place until June.

MEDICAL ELECTRICITY

A PAPER "On Measurement in the Medical Application of Electricity," was read before the Society of Telegraph Engineers, by Dr. W. H. Stone and Dr. Walter Kilner, on March 9. Dr. Stone commenced by stating that the subject had been suggested by Lieutenant-Colonel Webber, the chairman, and that the details the authors proposed to give that evening were mainly preliminary to fuller treatment, which they hoped to offer at some future period.

Medical electricity, he said, had been up to now a heterogeneous mixture of loose statements, doubtful diagnosis, and erroneous therapeutics. Glaring instances of these were given. With hysteria, Metallotherapy, and magnetic appliances, they did not propose to deal: science is in far too elementary a state to see through these obscure, though real phenomena. Probably, the key to the great enigma of the connection between electricity and nerve force had yet to be found. The bold statement that "electricity is life" is demonstrably false in many particulars. Speaking generally, medical electricity had suffered from its exclusive handling by physiologists and physicians, who might receive valuable help from physicists; indeed, the writers of the paper were actually soliciting such assistance at the hands of this young and active society. Medicine and its kindred arts lend themselves ill to measurement: the tone of mind required for their practice is rather judicial than computative; it is oftener concerned with weighing evidence, and balancing alternatives, than with solving equations. But men who work by measurement are usually sterling and accurate men; indeed, Prof. Schuster has recently shown how mathematics can help science. Where measurement *can* be used, it *should* be used; and this was their text for the evening.

The speaker then proceeded to divide the forms in which electricity had been used medically into four, namely—(1) continuous currents, (2) continuous currents made to intermit, (3) induced currents, termed generally "Faradisation," (4) statical electricity. The last of these was the first employed, but it had given the least satisfactory results of any. The third method had been far the most deeply studied. Duchenne's great work on Localised Electrisation early drew attention to this department. That genuine and indefatigable observer was able to point out so many definite diagnoses, and to isolate so many new nervous and muscular diseases by means of the induction-coil, that this instrument had been given somewhat excessive prominence as a therapeutic agent. Physiologists had also found in it a convenient stimulant for testing the action of nerves and the irritability of muscle; perhaps also the localisation of brain-functions. Hence muscular contraction and the action of intermittent currents in alternate directions had been too much relied on as evidence of activity. One chief object of the paper was to point out that the future of electro-therapeutics lies more in the continuous current, used either in its first or second form, the latter of which has hitherto received little or no attention. In confirmation of these views, extracts were read from Prof. Erb's valuable memoirs in Ziemssen's Cyclopœdia of Medicine.

Before, however, a single step could be taken in this scientific path, we must have some tolerably accurate mode of measuring the agent we are employing. It is obvious that the units used should be as far as possible those generally adopted in the scientific world.

To begin with resistance: This in the human body is singularly great, and is especially located in the epidermis, which, when dry, is an excellent insulator. Wetting it wtth sulphate of zinc or common salt diminishes this resistance very materially; though even when care is taken in this respect, the residual opposition to a current is large. From hand to hand it is usually about 6000 ohms. In the larger bulk of the trunk, from the sacrum to the nape of the neck, it never, even after long wetting, sinks much under 1500 ohms. That of the head, from nape to forehead, is about 2000 ohms. In one case it was more precisely 1930 ohms, in an adult, and in another, a child, 2500 ohms. The resistance of different tissues, though not exactly to the present purpose, had been studied by Prof. Eckhard, who stated that muscle was the best conductor, and that this being taken as a unit, cartilage would have a resistance twice, tendons and nerves about 2·1, and bone nineteen times as great. Matteuci states that muscles conduct four times as well as nerves, brain, or spinal chord. The resistance of the skin varies from day to day, being modified by moisture, and by the fulness of the capillary vessels. In a particular case, the positive pole of a battery was placed on the sacrum of a child, and the other on the leg, over the extensors of the foot. By using the same current, and adding quickly a known resistance, the resistance of the body was at first found to be 11,250 ohms, which, on thoroughly soaking the skin, was reduced 2875 ohms. Three days previously, the resistance before soaking was 13,000 ohms, and after that process sank to 3000 ohms. Personal idiosyncracy exercises an influence, a delicate skin conducting better than one which is coarse. The face and neck offer the least; the soles and palms the greatest resistance. Disease causes variation of conductivity: the skin over affected muscles in lead paralysis has its resistance increased, while in many old cases of hemiplegia it is decreased to a greater or less extent according to the amount of atrophy which has taken place.

The resistance of muscle in disease is sometimes diminished, sometimes augmented. Augmentation takes place, at the commencement of degenerative changes, from the inferior conductive power of fat to that of healthy muscle. In a case of infantile paralysis, the sound leg had a resistance of 2500 ohms, the affected leg of 3250 ohms. In a wasted muscle of many years' standing, the enormous resistance of 16,500 ohms was reached. It was both easy and desirable to multiply facts such as these.

The second preliminary point was the current which could be borne with impunity. Here results were very discordant. In the three fatal cases from touching the conductors of dynamo-machines, at a music-hall, in the Russian Navy, and at Hatfield, the necessary facts for measurement were absent; although Dr. Siemens had stated that he had often taken a current sufficient to produce a powerful light with impunity. In a case now in St. Thomas's Hospital, a current of 50 milliwebers was borne with difficulty, and one of 20 milliwebers with ease and great benefit. A case of diabetes, recorded by Dr. Stone in the *Proceedings* of the British Association at York in 1881, took about 10,000 micro-ampères, or 10 milliwebers, through his head, from nape to forehead, after some practice; using for its production from 15 to 20 cells of a bichromate battery. The particular battery, however, mattered very little; Leclanché's, bichromates and zinc-carbons with sulphate of mercury, all act well, and need not be of large size or small resistance. One was shown, in which test-tubes filled with mercuric sulphate, containing free acid, formed the jars; another in which a rod of zinc of 5-16″ diameter, and a similar sized carbon, such as is used in electric lamps, were immersed in the bichromate solution. Connection was here made with the carbon by a piece of drawn tube sprung on to it, thus doing away with the use of clamps. All these, as well as most of the apparatus shown, were made in Dr. Stone's workshop, chiefly with his own hands.

In consequence of the high resistance of the skin, it was essential to give a large size to the poles employed for applying the current, &c. Amalgamated zinc, with the mixture of potter's clay kneaded with the solution of common salt, used in physiological experiments, laid over it, was perhaps, theoretically, the best; but powdered carbon placed in a bag and immersed in salt and water, answered equally well; or the surgical appliance termed Spongio-piline, a thick felt, backed by india-rubber, through which a well-tinned copper wire was threaded, so as to encompass its whole circumference without anywhere projecting so as to touch the cuticle. The poles could hardly be too large.

A convenient form of Thomson galvanometer with graduated shunts, due to Dr. Kilner, was shown, and also a simple but effective instrument for producing intermissions in the current at any required interval of time. This apparatus consisted of a

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metronome with contact-pieces dipping into mercury-cups at each oscillation, a condenser being placed under the instrument to get rid of the extra current, and so to equalise the physiological effect of the making and breaking currents.

The measurement of induced currents presented considerable difficulties. The Conference at Paris had recommended the use of standard induction-coils, but this method does not give any but arbitrary measures. Dr. Stone had tried and showed a vacuum-tube, in which the tension of air could be varied by combining it with a barometric-column and a movable cistern. This gave a ready means of varying the force af the discharge, by using it as a shunt of variable resistance, and had the interesting results of shunting the "make-current" at a definite point, while allowing the "break-current," which is about six times stronger, to pass between the platinum points; thus obtaining an induced current in one direction only. Latterly he had adopted also condensers of definite capacity charged to definite potentials. The writers were, however, still experimenting with another method, depending on Sir W. Thomson's determinations of spark-length. The most practical method, at present, seemed to be to pass a continuous current of measured strength through an automatic commutator, which at alternate oscillations diverted it in one and the other direction. If there was any real physiological value in rapid reversals of direction, as was claimed by some experimenters, it could thus be secured, without the use of an induction coil. Another form of rotating-commutator was also shown, in which an ebonite cylinder, pressed on by six springs, at each quarter-turn connected, first, the condenser to the battery, so as to charge it, and then discharged it through the patient. To obviate the necessity of employing a large battery with the condenser arrangements, Planté's secondary battery could be charged in parallel position from a small number of Grove's cells, and discharged through the condenser in series. In all these contrivances, however, as the current gained in tension, it seemed to lose somewhat in chemical and catalytic power, and to assimilate gradually to the static form.

In the discussion which followed Mr. Preece pointed out that the use of electricity for curative purposes had been advocated as long ago as the year 1759, by John Wesley, and recommended the use of the dynanometer for the measurement of induced currents, as this instrument gave indications in the same direction with all currents. Prof. McLeod, Mr. Fitzgerald, and Prof. Ayrton also made comments on the paper.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—It is proposed to spend 300*l.* extra within the next three years for the following objects at the Botanic Gardens: thinning the belt and groups of trees; raising the level of some unoccupied areas and sowing them with grass; replanting the willow bed and making new beds; and the improvement of the collection of trees, already good, so as to keep up its special reputation.

Prof. Hughes having expressed to the Vice-Chancellor the serious difficulty found in carrying on practical studies in the Woodwardian Museum without additional class-room accommodation, it is arranged that Mr. Keeping, the curator, shall cease to reside in the museum, and be allowed an equivalent sum for house-rent and other advantages attached to the curatorship.

Prof. Humphry proposes to take classes in Surgery during the Long Vacation.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, January.—A new odontograph, by H. Bilgram.—Dimensions and performance of the hull and machinery of the U.S. steamer *Dispatch*, by chief-engineer Isherwood.—Mechanical drawing, by C. Sellers, jun.—The application of frictional electricity to the purification of middlings, by R. Grimshaw.—On the constants in Gordon's formula for the strength of columns, by M. Merriman.—Chronological table of American patents, by E. Hiltebrand.

Annalen der Physik und Chemie, No. 2.—On the elliptical polarisation of light in reflection at crystal surfaces, by E. Schenck.—Influence of mechanical hardness on the magnetic properties of steel and iron, by L. M. Cheesman.—On the maximum of magnetisation of diamagnetic and weakly-paramagnetic bodies, by H. W. Eaton.—On the reflection of electric rays; the influence of the cathode's form on the distribution of the phosphorescent light in Geissler-tubes; the connection between density of gas and layer-interval in Geissler-tubes; and the band-spectrum of air, all by E. Goldstein.—On the formation of peroxide of hydrogen during combustion, by A. Schudler.—Reply with regard to the formation-heat of water, by the same.—The expansion of water through absorption of gases, by K. Ångström.—Theory of refraction on a geometrical basis, by A. Kerber.—On the minimum of rotation of the light-ray in combined refraction and reflection at a sphere, by F. Kessler.—The minimum of deflection of a light-ray by a prism, and the minimum of time in refraction of light, by the same.—On electric shadows, by P. Riess.

Archives des Sciences Physiques et Naturelles, February 15.—A hypothesis on the origin of species, by M. Thury.—Determination of the quantity of organic substances contained in waters of the Rhône, by MM. Graebe and Guye.—Dry plants found in mummies, by Dr. Schweinfurth.—Study on the chemical composition of albuminoid substances (continued), by M. Danilewsky.—Swiss geological review for 1881, by M. Favre.

Journal de Physique, February.—Thermodynamic acceleration of the earth's motion of rotation, by Sir W. Thomson.—Imitation of the forces acting in a dielectric, by M. Elie.—Electric lighting, by M. Foussereau.—Projection of the focus of the prism, by M. Crova.—On a phenomenon of physiological optics, by MM. Macé de Lepinay and Nicati.

Natura, February.—On the origin of metamera, by G. Cattaneo.—On the origin of electricity of thunder-clouds (continued) by F. G. Nachs.—Some notes on radiophony, by E. Mirabelli.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xv. fasc. 1.—*Résumé* of meteorological observations at Milan, in the Brera Observatory, by P. Frisiani.—On linear systems, by E. Bertini.

Fasc. 2.—New indicator, at a distance, of the temperature of an inclosure, by R. Ferrini.—On two nummulitic deposits in the Pavian Apennines, by E. T. Taramelli.—Phosphates and wheat, by G. Cantoni.—On the theory of the diatomic scale, by E. Beltrami.—The double quadratic transformation of space and its application to non-Euclidean geometry of space (continued), by C. F. Aschieri.—Results of observations during 1881 at the Brera Observatory, on the diurnal excursions of the magnetic needle, by E. G. Schiaparelli.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, March 16.—Sir John Lubbock, Bart., M.P., F.R.S., president, in the chair.—Messrs. H. M. Brewer, V. I. Chamberlain, and A. P. Withiel Thomas were elected Fellows of the Society.—Mr. J. Worthington Smith called attention to certain very destructive Australian fungi new to England, viz. *Capnodium australe*, fatal to conifers, especially *Thuyas* and *Isaria fuciformis*, a great pest to grass in Kent and Sussex. The latter plant is popularly supposed to induce a disease similar to diphtheria, and said to be fatal to cattle. *Isaria* frequently grows on animal substances, dead and living, as on larvæ and pupæ of ichneumons, spiders, moths, wasps, &c.—Mr. Smith showed a bee caught alive in this country, and having a profuse growth of the *Isaria*-condition of the *Cordiceps sphecocephala*, a West Indian form, the latter genus being closely allied to *Claviceps*, or Ergot.—Dr. Francis Day read a paper upon the Salmones found in the British Isles, remarking how great changes are occasioned by retaining any of them in unsuitable localities. He objected to the augmentation in number of the British forms of migratory trout, from three to seven, as made by Dr. Günther, holding that we merely possess two. The Lochleven trout, which is in reality a marine form, acclimatized to fresh water, whereas the remainder are solely trout races of the common brook trout.—A most interesting fact was brought forward, viz. that Mr. Arthur, in New Zealand, having lately examined the trout which were introduced there in 1869 from ova originally obtained from the Thames and the west of England, found great structural changes had taken place. The fish in question, moreover, living in different streams in New Zealand had also assumed local peculiarities of size and change of form; and, doubtless due to increased food, the annual

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